

REMARKS/ARGUMENTS

The claims are 1-2 and 4-5 which have been rejected on the basis of the prior art. Specifically, claims 1 and 2 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Keller et al. U.S. Patent Application Publication No. 2002/0134706* in view of *Autenrieth et al. U.S. Patent No. 5,935,277* and *Stewen et al. U.S. Patent No. 5,137,602* as evidenced by *Sharma et al. U.S. Patent No. 4,741,515*. The remaining claims 4 and 5 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Keller et al., Autenrieth et al., Stewen et al.*, and further in view of *Vora et al. U.S. Patent No. 6,280,609* and *Apffel U.S. Patent No. 4,597,788*.

Essentially the Examiner's position was (1) that *Keller et al.* discloses the fission reactor for a Claus plant recited in the claims, except for a fill opening for introducing the catalyst bed and the checker bricks, (2) that *Autenrieth et al.* and *Stewen et al.* disclose these features, (3) that it is well known in the art that solid porous ceramic materials tend to provide for non-uniform flow as evidenced by *Sharma et al.* and

(4) that it would have been obvious to one of ordinary skill in the art at the time the invention was made to add the opening in the side of the reaction section as in *Autenrieth et al.* to the reaction system of *Keller et al.* and to add the checker pattern of the ceramic apparatus of *Stewen et al.* to the radiation barrier of *Keller et al.* in order to more easily remove catalysts and to provide a more uniform flow of gas.

Vora et al. was cited with respect to claims 4 and 5 as teaching the use of a portion of an effluent stream to a desired temperature prior to entering the reactor in order to eliminate the need for a charge heater and subsequently reducing the capital cost of the reaction system. *Apffel* was also cited with respect to claims 4 and 5 as teaching a temperature control valve that opens and closes a valve body which regulates flow of a temperature controlling stream in order to selectively control the temperature of a process stream.

This rejection is respectfully traversed and reconsideration is expressly requested.

As set forth in claim 1, Applicant's invention relates to a fission reactor for a Claus plant. In a Claus plant, hydrogen sulfide is converted to elemental sulfur, which is condensed and precipitated by means of cooling the process gas stream. In this connection, Applicant's fission reactor relates to a Claus plant in which a mixture of heating gas, air, and an acidic gas containing H₂S is introduced into a combustion chamber and jointly combusted in a combustion space. In order to be able to withstand the combustion, the boiler that accommodates the combustion chamber has a refractory lining. The gas mixture heated by the combustion of the heating gas is then introduced into a catalyst chamber having a catalyst bed, whereby the hydrogen sulfide that is passed in is converted to sulfur because of the high temperatures and the intensive contact with the catalyst bed.

With reference to a fission reactor for a Claus plant of the type in question, Applicant's invention as set forth in claim 1 is based on the task of reducing the system technology effort for the fission reactor of the Claus plant, whereby the fission

reactor is intended to function in reliable manner, while having a compact structure. In particular, the problem of the spread of flames from the combustion chamber must be taken into consideration, because these flames can damage the catalyst bed. See Applicant's disclosure at page 2, lines 6-8.

The task is accomplished, according to Applicant's invention as recited in claim 1, by configuring the boiler as a horizontal cylindrical boiler, in which the combustion chamber, the catalyst chamber, and the outflow-side chamber are disposed next to one another, and by delimiting the catalyst chamber on both sides, in the flow direction, by checker bricks that are gas-permeable, with the catalyst chamber having a mantle-side filling opening for introduction of the catalyst bed.

The primary reference to *Keller et al.* describes a method for desulfurization of a gas stream. See paragraph [0003] of *Keller et al.* In this connection, *Keller et al.* particularly set themselves the task of making available a method for the desulfurization of natural hydrocarbon gases ("natural gas"), in

order to make this method more easily usable. See paragraph [0005] of *Keller et al.* For a further explanation of the method proposed, *Keller et al.* first present various desulfurization methods known from the state of the art. Claus systems ("Claus plants") are also explained in this connection, merely with reference to the prior art in paragraph [0006] of *Keller et al.* In this connection, at page 1, paragraph [0006] lines 8-10, *Keller et al.* clarifies:

"The Claus process is not suitable for use in cleaning up hydrogen or light hydrocarbon gases (such as natural gas) that contain H₂S, however."

According to the further explanations provided in paragraph [0006] of *Keller et al.*, the unsuitability of the Claus process is particularly attributable to the loss of hydrocarbons as a result of the combustion during the Claus process and the inability to manage the problem of contamination of the catalyst. The other desulfurization methods known from the state of the art also require improvement, so that *Keller et al.* propose a method

that deviates completely from the prior art and, in particular, from the Claus process, whereby a direct partial oxidation is provided directly at the catalyst. See paragraph [0003] of *Keller et al.* In this connection, the hydrocarbon gas is supposed to be oxidized to the lowest possible degree. Instead, selective oxidation of H₂S is supposed to take place, in order to make the reaction heat available for the formation of synthetic gas. In order to allow selective oxidation, substance conversion takes place only during extremely short contact of the gas mixture with the catalyst. The duration is preferably supposed to be less than 10 milliseconds. See paragraph [0033] and claim 39 of *Keller et al.* Because of the short contact provided according to *Keller et al.*, the result is achieved that chemical equilibrium does not occur. See paragraph [0028] of *Keller et al.* as follows at page 4, lines 2-5:

"Because the process of the present invention promotes the reaction H₂S+1/2O₂-1/x S_x+H₂O (x=2, 6, or 8, preferably 2), it avoids the Claus reaction equilibrium restriction imposed by combustion of H₂S to SO₂."

The method described by *Keller et al.* is thereby explicitly differentiated and distinguished from a Claus process. See also paragraph [0079] of *Keller et al.* at page 11, lines 7-8:

"substituting the new H₂S partial catalytic oxidation process in place of a Claus-type process"

The process proposed by *Keller et al.* also requires a completely different apparatus design, as compared with the Claus process. In particular, *Keller et al.* clarifies that only by means of the special process proposed by *Keller et al.* is a compact method of construction made possible as follows at page 3, paragraph [0028] lines 4-5 of *Keller et al.*:

"The new process eliminates the need for large vessels operating at low pressures...."

According to the process proposed by *Keller et al.*, partial catalytic oxidation of sulfur ("sulfur catalytic partial oxidation - SCPOX") takes place. Combustion of the gas mixture

that is fed in is not provided in this connection. In particular, combustion before passing through the catalyst must be avoided as follows at page 4, paragraph [0030] lines 12-16 of *Keller et al.*:

"A porous thermal shield is preferably included in the reactor between the mixing zone and the reaction zone to help prevent pre-ignition and combustion of the reactant gases prior to contacting the catalyst."

The device of *Keller et al.* does not have a combustion chamber in the sense of Applicant's claim 1. In *Keller et al.*, the gas that is fed in has a temperature between 40 and 350°C in the mixing chamber, preferably not more than 200°C. See last sentence of paragraph [0066] of *Keller et al.* Accordingly, the problem of flames breaking through also does not occur. Furthermore, a refractory lining is not necessary for this reason, and it is also not described in *Keller et al.* In *Keller et al.*'s specification (see paragraph [0067], for example), it is merely stated that in order to avoid temperature losses, a

radiation barrier is provided as insulation ("thermal radiation barrier 46"); however, it can be seen in FIG. 2 that the reference symbol 46 refers not to a lining, but rather to a separation element disposed in the diameter of the device.

Because the gas that is passed through the system is supposed to be in contact with the catalyst only for a short period of time of preferably less than 10 milliseconds, a material introduced into an intermediate space as a catalyst bed also cannot be provided as a catalyst. Instead, thin layers or mats are provided (See paragraph [0051] of *Keller et al.*), which are suspended in the device. The catalyst mats described by *Keller et al.* fill the entire diameter, and thus cannot be introduced through a simple mantle-side filling opening. Because of the low thickness that is necessarily required, it is also not possible to replace a pourable material through a mantle-side filling opening, over the entire diameter. If replacement of the catalyst mats described should be necessary, it is respectfully submitted that a person skilled in the art will usually take into consideration, in the case of the embodiment according to FIG. 1

of *Keller et al.*, to configure the entire housing, as such, in two parts, or to provide it with a removable lid in the longitudinal direction, so that the catalyst mat can be pushed in, in the longitudinal direction.

With regard to *Keller et al.*, it should be stated, in summary, that *Keller et al.* describes a method for desulfurization, which differs fundamentally from a Claus process, and is also explicitly distinguished from a Claus process. In the case of the method disclosed in *Keller et al.*, the equilibrium of the Claus reaction is therefore not achieved. For this purpose, a special design configuration is required, which is not comparable with the configuration of a Claus reactor. Only by means of the method described by *Keller et al.* does a compact structure become possible. Aside from the fundamentally different way of conducting the process, the essential characteristics of a splitting or fission reactor for a Claus system are also not implemented. The known device of *Keller et al.* has neither a combustion chamber nor a refractory lining. Thin mats are necessarily provided as the catalyst, in

order to guarantee only short contact with the process gas.

Placement of a catalyst bed in a catalyst chamber is therefore also not disclosed or suggested by *Keller et al.* Because of the different way of conducting the process, there is also not the problem of flames breaking through, so that a person skilled in the art will not consider delimiting the catalyst chamber with checker bricks having oblong holes. Finally, the catalyst mats described by *Keller et al.* cannot be replaced through a simple mantle-side filling opening, so that a person skilled in the art does not receive any inspiration for such an embodiment, either. The possibility of disposing the boiler of a Claus system to lie horizontally is also nowhere disclosed or suggested by *Keller et al.*

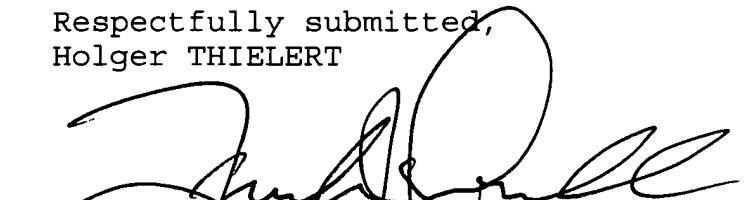
Because of the fundamental differences, it is respectfully submitted that a person skilled in the art will not use *Keller et al.* to improve the design of a splitting reactor for Claus systems. As explained above, the essential characteristics of a splitting reactor for Claus systems are nowhere disclosed or suggested by *Keller et al.* and the object of Applicant's

invention as recited in claim 1, therefore, is not evident even when taking into consideration the other prior art, which is relevant merely with regard to individual partial characteristics, and also does not relate to the fundamental structure of the splitting reactor according to the invention as recited in Applicant's claim 1.

Accordingly, it is respectfully submitted that claim 1 is patentable over *Keller et al.* alone or in combination with the secondary references to *Autenrieth et al.*, *Stewen et al.*, *Sharma et al.*, *Vora et al.* and *Apffel*, together with claims 2 and 4-5 which depend directly or indirectly thereon.

In view of the foregoing, it is respectfully requested that the claims be allowed and that this application be passed to issue.

Respectfully submitted,
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Enclosure: Copy of Petition for two-month Extension of Time

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